REFRIGERATION

INCLUDING HOUSEHOLD AUTOMATIC REFRIGERATING MACHINES

BY

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FIRST EDITION
THIRD IMPRESSION

McGRAW-HILL BOOK COMPANY, INC.
NEW YORK: 370 SEVENTH AVENUE
LONDON: 6 & 8 BOUVERIE ST., E. C. 4
1928

dioxide, ethyl chloride, methyl chloride, ammonia, carbon dioxide (not commonly used in America but used extensively in Europe), butane, isobutane, methane, ethane, and propane. These refrigerants can be classified into two groups: (1) non-inflammable and (2) inflammable. The non-inflammable refrigerants are carbon dioxide and sulphur dioxide. The remainder of the group may burn when mixed in some proportions with air and must, therefore, be classified as inflammable. Not all of the above refrigerants are widely used in household machines. Those most commonly found are sulphur dioxide, methyl chloride, and ammonia. Isobutane and butane have been used to some extent.

General Electric Company Refrigerating Unit.—The General Electric household refrigerator has been designed to occupy as little space as possible and to eliminate all exposed moving parts. It has been arranged to simplify the interchange of refrigerating units and to reduce to a minimum the possibility of gas leaks. An automatic control maintains constant refrigerating temperature. The refrigerant used in this machine is *sulphur dioxide.*

The General Electric unit resembles in many ways the Audiffren oscillating-cylinder refrigerating machine (see p. 51), which has been successfully used for 25 years. There are four principal parts in the refrigerating unit; namely, (1) compressor, (2) float chamber, (3) evaporator, and (4) automatic temperature control.

Compressor.—The compressor of the General Electric unit is shown in Fig. 66. It has a single *oscillating* cylinder C, and its piston is driven by an eccentric on the shaft of the electric motor M. The compressor is single acting. The compressor and motor are in a steel case which is provided with a steel base plate. The joint between the case and the base plate is made thoroughly leakproof by means of a tongue-and-groove type of lead seal. Lubrication is by the forced-feed method that operates by means of a plunger type of oil pump which operates on the permanently sealed oil supply, somewhat as the piston of the compressor operates on the refrigerant. The oil pump is not shown in the figure.

In order to reduce the starting torque of the compressor, an "unloader" valve H is used. This valve is held up against its seat by oil pressure during the normal operation of the compressor but opens at the low oil pressure when starting, thereby allowing

the pressure on the outside and inside of the compressor cylinder to become equalized through a bypass. At the time of starting, a check valve *G* closes and thus prevents the vapor of the refrigerant from leaking back into the evaporator through the suction line. The entire mechanism is mounted within a steel case by means of a three-point suspension, so as to absorb motor noises and vibrations. This makes the machine practically noiseless. The suction pipe is a tube which is wound around the compressor

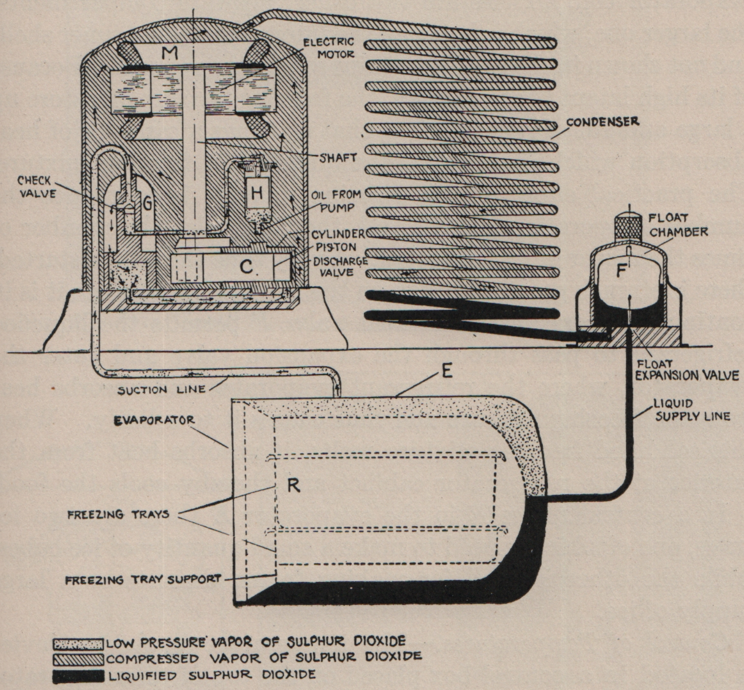

FIG. 66.—Diagram of General Electric icing unit.

between the base plate and intake opening of the cylinder to permit the free movement of the suction pipe without danger of breaking.

Float Chamber.—The float chamber *F* is located on the top of the refrigerator cabinet at the right of the compressor case. Its purpose is to accumulate the liquid refrigerant, and when there is a sufficient quantity of liquid in the chamber, the float valve[1]

[1] The pressure and temperature to be maintained in the evaporator determine the adjustment for opening this float valve.

lifts and allows the liquid refrigerant to flow into the coil of the evaporator.

Evaporator.—The evaporating device is located on the inside of the cover of the cabinet and is an integral part of the unit. The evaporator *E* is made of three tested steel shells which are nested together and welded at the open ends. The inner and intermediate shells have circular cross-sections. Between the nearly square outer shell and the intermediate shell is the space for the evaporator coil. There are two other, separate compartments; the larger one, which is between the intermediate and inner shells and not shown in the figure, contains a freezing mixture. Because of its high latent heat of fusion, the freezing mixture can store up a large amount of refrigeration; that is, it has a capacity of heat absorption which depends on the quantity of freezing mixture. The practical effect of this freezing mixture is to reduce the number of operating periods and, therefore, also the number of times the motor must be started. Every time the unit is started, there is a much greater burden on the machine than when it is in continuous operation. The float valve *F* permits the liquefied refrigerant to pass through the expansion valve and enter the evaporator, where the refrigerant evaporates and absorbs heat from the freezing mixture and thus causes it to solidify. When this solidified freezing mixture melts, it absorbs heat from the interior of the refrigerator cabinet and thereby cools the food.

In a central recess *R* in the evaporator *E* there are two ice trays, one of which is used to make a small quantity of ice cubes, while the other is used for making frozen desserts or a large supply of ice.

Control of Temperatures.—The temperature-regulating device is located in a control box placed on the top of the refrigerator cabinet to the left of the compressor, as shown in Fig. 67. This control performs three functions: (1) It starts and stops the electric motor as the temperature changes in the evaporator; (2) it cuts off the current whenever there is an overload, thus preventing damage to the motor; and (3) it reduces the torque to be overcome by the motor when starting.

Temperature control is secured by means of a "sylphon-bellows" type of *pressure-regulating* valve (Fig. 68) to which a copper tube is attached at one end while the other is fastened to the back of the evaporator. This copper tube contains sulphur dioxide from the refrigerating system. At high temperatures in the evapo-

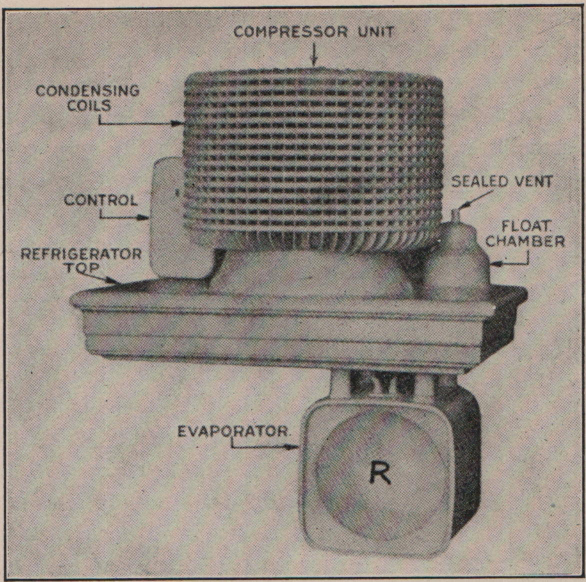

Fig. 67.—General Electric icing unit showing parts in place.

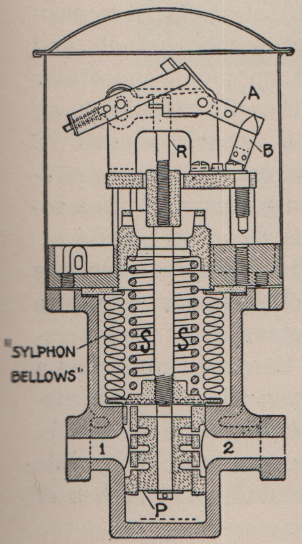

Fig. 68.—"Sylphon" bellows for electric switch operation.

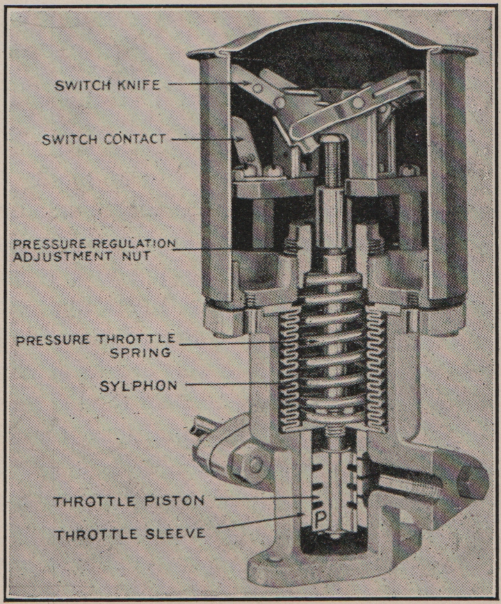

Fig. 69.—Sectional pictorial view of "Sylphon" bellows for electric switch operation.

rator, the sulphur dioxide evaporates and increases the pressure in the tube and in the sylphon-bellows valve, so that the latter expands and closes a switch at the top of the device, *which* starts the motor. On the other hand, a decrease in temperature in the evaporator causes a reduction in pressure in the sylphon-bellows valve, opens the switch, and cuts off the electric current of the motor, thereby stopping the compressor. This device is used in a number of makes of household refrigerating systems. It is shown pictorially in Fig. 69.

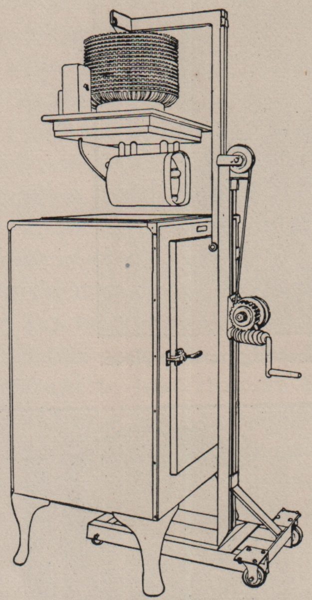

FIG. 70.—Portable crane for removing General Electric icing unit.

A thumbscrew adjustment is provided so as to decrease or increase the tension of the spring in the folds of the sylphon-bellows valve. This adjustment permits the temperature-control unit to be set for the proper temperature in the refrigerator. In order to prevent damage from overload, an overload tripping switch is provided in the electric circuit to prevent an excessive current.

The installation of this refrigerating unit consists only of placing it in position at the top of the cabinet; and since there are no pipe connections to be made, it is easily installed in an apartment or a house. Figure 70 shows a crane for conveniently removing and replacing this unit in a refrigerator. A portable refrigerating unit is shown in Fig. 71.

At the factory, the standard method of testing this machine is to submerge the evaporator in a brine bath held at a temperature of 20° F. while the condenser for the refrigerant is at room temperature. With these conditions, one of the small units has a refrigerating capacity of 320 B.t.u. per hour, when the electric-power input is 150 watts and the room temperature is 100° F. The condenser gage pressure is 110 pounds per square inch while the suction pressure corresponds to a vacuum of 4 inches of mercury.

When this refrigerating unit is installed in a room having a temperature of 100° F., it will run about 70 per cent of the time

when the doors of the refrigerator are kept closed. Under this condition, the average suction pressure is slightly lower than during the brine test method above, and the refrigerating capacity of the machine will be slightly reduced.

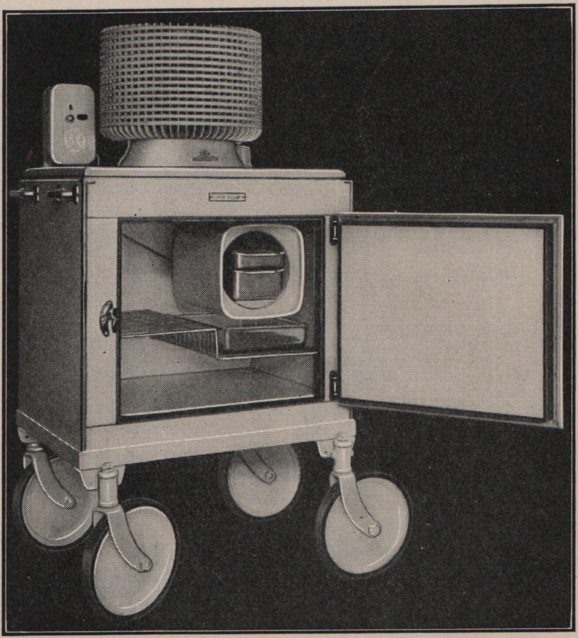

Fig. 71.—Portable General Electric icing unit, and refrigerator.

The Frigidaire Compression Refrigerating System.—The Frigidaire system made by the Delco-Light Company (General Motors Corporation) is of the compression type and operates according to the following cycle: The heat is absorbed from the refrigerator cabinet by the evaporating refrigerant, which is *sulphur dioxide,* and is carried away by the cooling water or air, whichever cooling medium is used for the condenser. The compressor, driven by an electric motor, serves to keep the refrigerant circulating through the system and increases the pressure of the refrigerant so that it may be readily liquefied in the condenser. The liquid sulphur dioxide which has been condensed drops into a pocket or sump of the compressor from which it is forced by difference of pressure through a tube into the cooling coil of the evaporator. The flow of the liquid sulphur dioxide into the cooling coil is controlled by an expansion valve of the